SOME OCEAN PHENOMENA

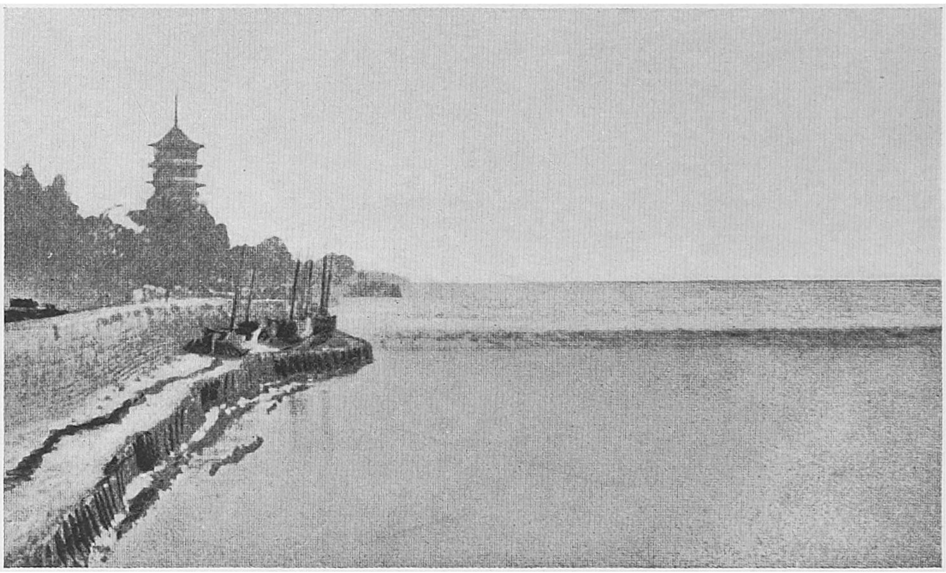
SEA-WATER differs from rain-water, well-water, river-water. True, it is made up of all these, since sooner or later and in one mode or another all water on earth finds its way to the ocean. Water may travel openly by river-routes; it may creep silently by dark and devious underground passages; it may float lightly via cloud-land; but in any case its goal is the sea.

Still, though the ocean includes in its composition every kind of land-water, sea-water as such is different from them all. Not only in its vast extent, in its enormous depth, but in its strong flavour of salt.

Where all the salt in the ocean comes from, is a complex question. Large supplies are brought down annually by rivers and streams, from various minerals in their beds, as well as from rock-salt regions. But if we ask, "How comes the rock-salt to be there?" we are told that it is a deposit, once formed beneath ocean-waters, or at least left by the drying up of salt lakes and seas. A proof of the latter theory is found in multitudes of sea-shells, often distributed through layers of rock-salt.

If much sea-salt came originally from rock-salt on land, and if rock-salt came originally from ocean-deposits, we are led into a curious circle of cause and effect—not unlike that of oak and acorn, or of hen and egg, with the attendant puzzle of—Which first? It is a query which we are not able to answer.

Great districts of rock-salt are found in many places—such as those in the Carpathian Mountains, in the Swiss Alps, in Germany, and in Great Britain. One huge mine in Galicia has



Bore of the Tsien Tang Kiang

been worked for six hundred years; and this supply is said to reach through about five hundred miles. But land-supplies grow pale and insignificant before the quantities which float in the ocean. It has been reckoned that, if the waters of the whole ocean could be dried up, the amount of salt left lying on the ocean-bed would be something like four-and-a-half millions of cubic miles.

During the south-west monsoon the ocean waters are forced by powerful winds up the Gulf of Cutch, India, to a considerable height, overspreading the Rann, a large flat plain, which for a time is turned into a shallow lake. When dry weather comes, the water vanishes, partly retiring, partly evaporating; and a salt-strewn desert is left, varied by sand-ridges, green spots, and little lakes, but covered principally by "sheets of salt crust," looking much like snow, in such quantities that it can be scraped up by the hand.

The outer crust of the earth, taking land and sea together, may be divided into three distinct parts. Like most such divisions in nature, the one is often found to glide by gentle stages into another.

We have, first, land, rising above the sea-level, and consisting of plains, undulations, hills, mountains. It covers altogether less than one-third of the earth's surface, and it is called the continental area, though islands as well as continents belong to it.

We have, secondly, the ocean-floor under deeper parts of the ocean; that which lies beyond a depth of about two miles. This division has been described as the "great submerged plain," and it comprises about one-half of the earth's surface. It is known as the abysmal area.

We have, thirdly, a middle region, which may be spoken of as a kind of borderland under the sea, connecting the dry land with the greater ocean-depths. It amounts to about one-sixth of the earth's surface, and it has been named the transitional area.

A curious law seems to have governed the grouping of land and water. Agnes Giberne states it in her "Romance of the Mighty Deep." Putting aside innumerable small islands, scattered about, we find that the great mass of land clusters towards and round the north pole, with a water-and-ice-filled hollow for its centre. While, on the contrary, the greater mass of water may be said to cluster towards and round the south pole, with—so far as we can conjecture—a large extent of land for its centre. The conditions of north and south thus seem to be exactly reversed.

The ocean-bed is held to be generally flat, though with gradual slopes here and there, leading up or down to higher or lower levels. But many submarine mountains rear their heads, sometimes near the surface, sometimes above it. In places high mountain-ridges run for a long distance below the sea, with profound depths on either side; and these again often show their peaks, forming groups of islands.

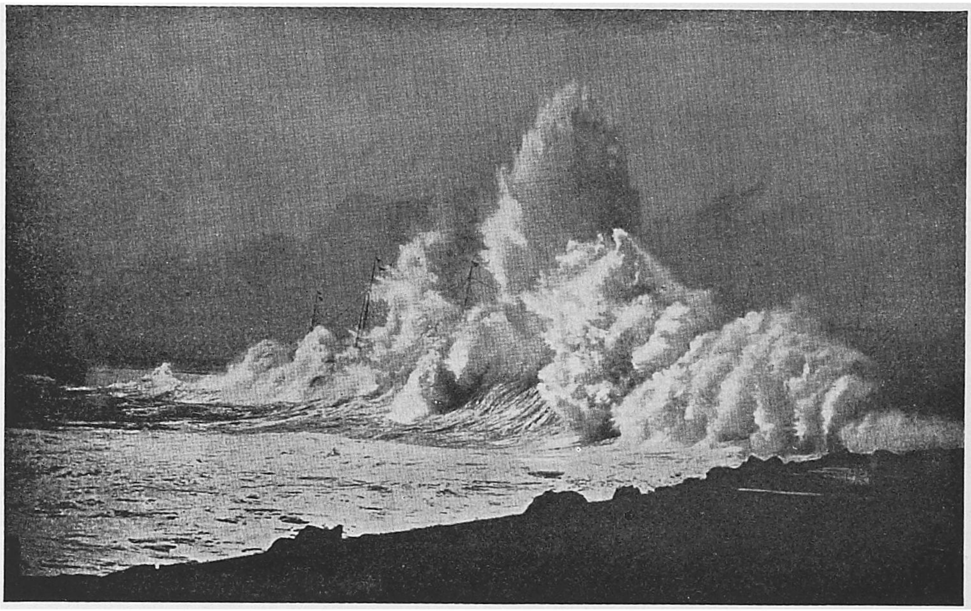
Broad reaches of the ocean are between two and three miles deep, and here and there spots are found where the sounding-line goes sheer down three miles, four miles, five miles, even six miles, before touching bottom. These greater depressions have been named "deeps."

At least fifteen of them are known in the Atlantic, and twenty-four in the Pacific; many of the latter lying close to islands. Some are long in shape, some short; some are broad, some narrow. One of the most profound, and almost the only one known to exceed five thousand fathoms, lies towards the south-east of the Friendly Islands. A depth there has been found five hundred and thirty feet beyond five geographical miles; and five geographical miles are equal to almost six of our common miles.

For a good while the notion was entertained that, probably, the loftiest mountain-peak on land, and the deepest depth in the ocean, would about match one another, reckoned from the sea-level. But this particular "deep" in the Pacific sinks two thousand feet lower than the topmost peak on earth rises. Mount Everest, in the Himalayas, is twenty-nine thousand feet high; and this ocean-depth is about thirty-one thousand feet deep. Only one other equal to it has yet been discovered.

Absolute placidity in the ocean is a thing unknown. Even when the waters are at their stillest they are always being drawn steadily towards earth's centre.

If we could look upon the earth, with large far-seeing eyes, from a few thousands of miles off, we should find curious irregularities in the watery outline. Instead of showing all round a smooth surface, the ocean would be found to rise here and sink there, to be in one part higher, in another part lower. A man roving over the ocean, all about the earth, would have in places to ascend undulations like hills, almost high enough to be called mountains, in other parts to descend declivities.



Burst of the South-west Monsoon Against the Colombo Breakwater

Most of us have noticed in a cup filled with water, that the water-surface is not perfectly flat. Close to the sides of the cup may be noticed a distint rise. With the ocean the very same thing is seen. If high land borders on

deep water, the extra attraction of mountain-masses will act just as the sides of a cup or tumbler will act. The enormous masses of the Himalayas are supposed to exert a powerful drawing upon the nearer parts of the sea; and at the delta of the Indus, perhaps partly in consequence of it, the ocean level is three hundred feet higher than on the coast of Ceylon.

To a very large extent tides are due to the attractive power of the moon. They are due also to the sun, but in a much less degree, which at first sight seems singular, since the attraction of the sun, by reason of its greater size, far exceeds that of the moon. From the fact, however, that the powerful drawing of the sun comes from an immense distance, it follows that it has much less effect than the small attraction of the moon, which comes from very near at hand.

Her influence over our earth is exerted far more strongly with respect to those ocean-waters lying just under herself, and far less with respect to those waters on the farther side of the globe. The effect of these different pullings is to raise a double wave or swell,—one on the surface of the ocean just below the moon, and one on the opposite side of the earth. The waves mean high tides; and low tides occur at places halfway between them.

Were the whole earth covered by one continous sheet of water, these tidal waves would travel round and round the globe, in a fassion easy and pleasant for students of the subject. But in the northern hemisphere, where land is abundant, the tidal waves are greatly interfered with by continents and islands. Often the most that each can do, as it sweeps along, is to send side-waves and currents journeying northward into channels and bays, estuaries and lesser seas.

Through the open ocean the tidal wave has no great height. Probably in central regions of the Pacific it rises only some three or four feet above the usual sea-level. But when the flow enters narrowing bays and channels, a very different result is seen; and the waters are often piled up in a wonderful manner,—as in the Bristol Channel, and in the Bay of Fundy, where the level at high tide is sometimes nearly forty feet above that at low tide.

A marked contrast to this is seen in the Mediterranean. There, as already said, practically no tides exist. The rise and fall amount at most to only a few inches. Instead of a wide entrance and a narrowing estuary, we have just the opposite—a narrow entrance and a widening sea beyond. Connection with the outside ocean is too restricted to admit of any full flow of the tidal wave.

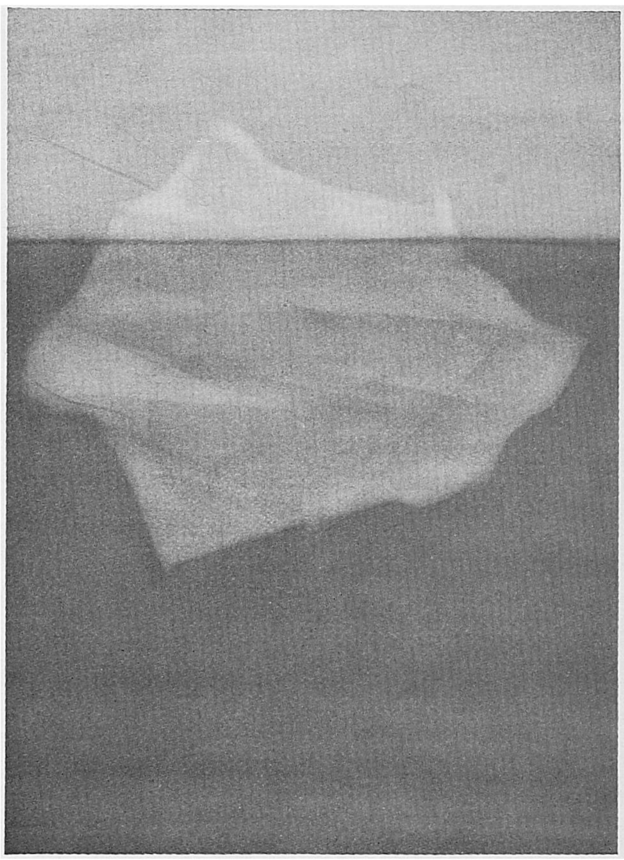
Solar tides, or tides brought about by the sun's attraction, are much the same in cause and effect as lunar tides, only far smaller in degree. When sun and moon happen to be on the same side of the earth, or on different sides but in the same line, so that their combined pull is exerted in one direction, we have spring tides. These are always at the time of new moon and full moon. Sun and moon then work together, each helping the other in a common aim; and the ocean-waters rise higher and sink lower than at other times.

When sun and moon are so placed with regard to the earth, that they exercise their pull in a cross direction, neap tides result,—that is tides which

have small ebb and flow. In this case the sun hinders instead of helping the moon, and the moon does the same for the sun, each tending to counteract the work of the other.

Connected with and partly caused by the rise of the tide is the curious phenomenon known as a "bore"—a single high wave, moving onward like a wall of water, with great rapidity and a roaring noise. More usually this belongs to a river, and thus it has not much connection with the subject of the ocean; but it is also sometimes seen in sharply narrowing estuaries or ocean inlets.

To the inhabitants of a flat and unprotected country, bordering on river or estuary, the bore is often a thing of terror, for its advent is uncertain and abrupt, and in its upward rush it sweeps everything before it. The entering of such a wave into the Severn is an almost daily event, and it reaches often a height of many feet. Bores are usual, too, in the River St. Lawrence, in the Hoogly, in an estuary of the Bay of Fundy, and in other places innumerable; and they vary in height from two or three feet to over twelve feet.



An Iceberg, showing the section under water

For every cubic foot above water there are seven cubic feet below

If at the height of some fierce tornado, a sailor could leave his tossing straining ship, and could dive far into the sea, keeping breath and sense and life, he would soon quit the turmoil, and would find himself in a scene of deep repose. Wave motion does not descend much below the surface. It is believed that the depth of water affected by a wave is usually about equal to the space which divides crest from crest. So, if we are looking at little ripples, flowing one after another, with crests perhaps one foot apart, we may suppose that the water is disturbed by those ripples to a depth of about one foot. Or, if we are watching larger waves, with crests twenty feet apart, we may suppose the disturbance to reach down to a depth of some twenty feet. And if our gaze is fixed on dignified Atlantic rollers, with crests six or eight hundred feet apart, we may suppose that the sea is affected to a depth of six or eight hundred feet—less and less affected the deeper we go down. As the thickness increases, more and more rays of sunlight are taken captive, and the water becomes less and less translucent, till at length, if we

could get deep enough, we should find ourselves to be surrounded with blackness.

Changes from season to season like changes of weather, are superficial. At a depth of about six hundred feet, seasons have ceased to be. There, summer and winter, autumn and spring, exist no longer. The dead level of calm and darkness is also a dead level of uniform weather and unalterable climate. Where changes of cold and heat do come about, they are very uncertain, and usually they are due to other causes than those which bring about the succession of seasons upon earth.

Many remarkable facts have lately come to light with respect to ocean's temperatures. In far northern and far southern regions, near the two poles, the whole sea is very cold. One might expect the converse of this in tropical regions—a whole sea intensely warm. But this we do not find. The shallower parts—those included in the hundred-fathom limit—may be nearly as warm below as above. When, however, deep-sea soundings are made, when the registering thermometer is despatched on its mission of inquiry miles below the surface, then the report brought up is generally of great cold.

In almost all deeper parts, the tale is told of a frigid under-layer,—of water nearly and sometimes quite down to the freezing-point of fresh water. This, not only in Polar Seas, not only in temperate ocean's, but in the hottest portions of the tropics. The Atlantic, near the equator, is icy in its depths.

Icebergs originate in glaciers. A glacier is literally an ice-river, a huge long tongue of ice, squeezed from beneath snow-fields, and creeping down a valley. Such rivers vary much in size. Some of the Swiss glaciers are between twenty and thirty miles long, in parts two or three miles wide, and often hundreds of feet deep.

But Switzerland's grandest glaciers dwindle into insignificance beside the enormous ice-rivers of the frozen north. When the "Humboldt Glacier" of Greenland gets to the ocean it is about forty-five miles in width. The Greenland Glaciers reach the sea, each thrusting an enormous "foot" far into deep water. The upward pressure of the sea becomes increasingly great, fighting against the tenacity of the ice, and in the end old ocean has the best of the contest. A huge mass of ice snaps off from the glacier-foot and springs to the surface, making the waters seethe and swirl with the shock, and sending heavy waves in all directions. Then the buoyant mass floats away as a newly-made iceberg.

Some icebergs, broken thus from a Greenland glacier, are two or three hundred feet high. That is to say, a sailor on board a ship can see two or three hundred feet of solid ice above the surface of the sea. But this is by no means the true iceberg height.

When we talk of ice "floating," we do not mean that the whole piece of ice rests upon the top of the water. It floats in the water. Only about one-eighth of it is visible above, and the other seven-eighths are hidden below. So, in the case of an iceberg rising two or three hundred feet above the sea, we may be sure that at least seven times as much ice is underneath the ocean-surface. This shows what an enormous mass the whole of a floating ice-mountain must be.